

REMARKS

Applicants have amended claims 11, 13, 15 and 19-24, and have canceled claims 1-10, 12 and 14 during prosecution of this patent application. Applicants are not conceding in this patent application that said amended and canceled claims are not patentable over the art cited by the Examiner, since the claim amendments and cancellations are only for facilitating expeditious prosecution of this patent application. Applicants respectfully reserve the right to pursue said amended and canceled claims, and other claims, in one or more continuations and/or divisional patent applications.

The Examiner rejected claims 11, 13, 14 and 17-24 under 35 U.S.C. §102(e) as allegedly being anticipated by Kuehne et al. (US Pat. 6,372,605, hereinafter Kuehne).

The Examiner rejected claims 11, 13, 14 and 17-24 under 35 U.S.C. §102(e) as allegedly being anticipated by Jang et al. (US Pat. 6,869,858, hereinafter Jang).

The Examiner rejected claims 15, 16 and 20 under 35 U.S.C. 103(a) as allegedly being unpatentable over Jang et al. (US Pat. 6,869,858).

Applicants respectfully traverse the §102(e) and §103(a) rejections with the following arguments.

First Rejection 35 USC § 102(e)

The Examiner rejected claims 11, 13, 14 and 17-24 under 35 U.S.C. §102(e) as allegedly being anticipated by Kuehne et al. (US Pat. 6,372,605, hereinafter Kuehne) stating: “Kuehne in figs. 2A-2F disclose a method of fabricating a filled trench structure, comprising: (a) forming a planarization stop layer 242 on a top surface of a substrate 240 (fig. 2A); (b) forming a first set of trenches (narrow trenches) in a first region and a second set of trenches (wide trenches) in a second region, trenches in first set of trenches having a higher aspect ratio than trenches in second region; (c) depositing a fill material 248 in first and second set of trenches and on a top surface of planarization stop layer 248, fill material completely filling trenches (fig. 2B); (d) forming a mask layer 250 on said fill material 248 (fig. 2C)[;] (e) removing an upper portion of fill material 248 by an etched back process (fig. 2D and col. 4, line 66 through col. 5, line 2); (f) removing masking layer 250 (col. 5, line 3); and (g) removing, using a planarization process, all fill material from top surface of planarization stop layer, a top surface of fill material in first and second sets of trenches co-planer with top surface of planarization stop layer (fig. 2E and col. 5, lines 12-17).”

As to claim 11, Applicants respectfully contend that Kuehne does not anticipate claim 11, as amended, because Kuehne does not teach each and every feature of claim 11. For example, Kuehne does not teach “a first thickness of said layer of said fill material directly over each trench of said first set of trenches greater than a second thickness of said layer of said fill material directly over each trench of said second set of trenches, said first and second thicknesses measured perpendicularly from a plane coplanar with said top surface of said planarization stop layer to a top surface of said layer of said fill material.”

Applicants respectfully point out, that in the process illustrated Kuehne FIG. 2B, (and FIGS. 2C, 2D and 2E) clearly shows the thickness of layer 248 to be the same over trenches 244 on the left side of FIG. 2B (narrow trenches) and over trench 244 on the right side of the FIG. 2B (wide trench). Applicants can find nothing in the written specification to the contrary.

Support for the limitation “a first thickness of said layer of said fill material directly over each trench of said first set of trenches greater than a second thickness of said layer of said fill material directly over each trench of said second set of trenches, said first and second thicknesses measured perpendicularly from a plane coplanar with said top surface of said planarization stop layer to a top surface of said layer of said fill material” is found in Applicants FIG. 3 and paragraphs 0019 and 0020 discussion of heights H2 and H3.

Support for the negative limitation “non-selectively removing” in amended claim 11 is found in paragraph 0034 of Applicants specification which states in part “The major difference between the first and second embodiments of the present invention is that no masking step is performed in the second embodiment of the present invention.”

Based on the preceding arguments, Applicants respectfully maintain that Kuehne does not anticipate claim 11, and that claim 11 is in condition for allowance. Since claims 13, 15-18, 25 and 26 depend from claim 11, Applicants contend that claims 13, 15-18, 25 and 26 are likewise in condition for allowance.

As to claim 17, Kuehne does not teach and the Examiner did not assert that Kuehne teaches “wherein said first region is a memory cell array region and said second region is a support circuit region of an integrated circuit” as Applicants claim 17 requires. Applicants

cannot find this limitation in Kuehne and respectfully request the Examiner point out where this limitation is found in Kuehne.

Based on the preceding arguments, Applicants respectfully maintain that Kuehne does not anticipate claim 17, and that claim 17 is in condition for allowance.

As to claim 19, Applicants respectfully contend that Kuehne does not anticipate claim 19, as amended, because Kuehne does not teach each and every feature of claim 19. For example, Kuehne does not teach “a first volume of fill material in said first region not completely contained in said trenches of said first set of trenches is about equal to a second volume of fill material in said second region not completely contained in said trenches of said second set of trenches.”

Applicants cannot find any teaching of *relative* volumes of the two regions in Kuehne. There is no such teaching in the text of the specification and such a teaching can not be determined from the two-dimensional drawings of Kuehne FIGs. 2A through 2E.

Based on the preceding arguments, Applicants respectfully maintain that Kuehne does not anticipate claim 19, and that claim 19 is in condition for allowance.

As to claim 21, Applicants respectfully contend that Kuehne does not anticipate claim 21, as amended, because Kuehne does not teach each and every feature of claim 21. For example, Kuehne does not teach “wherein (d) reduces the difference between a volume of said fill material over first region and a volume of said fill material over said second region.”

Applicants cannot find any teaching of a reduction in the *difference* in volume between two regions in Kuehne. There is no such teaching in the text of the specification and such a

teaching can not be determined from the two-dimensional drawings of Kuehne FIGs. 2A through 2E.

Based on the preceding arguments, Applicants respectfully maintain that Kuehne does not anticipate claim 21, and that claim 21 is in condition for allowance.

As to claim 22, Applicants respectfully contend that Kuehne does not anticipate claim 22, as amended, because Kuehne does not teach each and every feature of claim 22. For example, Kuehne does not teach “(d), after (c): (i) forming a mask layer on said layer of fill material; (ii) forming a opening in said mask layer in said first region and over trenches of said first set of trenches; (iii) removing a layer of said layer of said fill material exposed in said opening, said fill material still completely filling each trench of said first set of trenches; and (iv) removing said masking layer.”

Applicants point out that In FIG. 2C of Kuehne that opening 252 in photoresist layer 250 is not over any of narrow trenches 244 (see Kuehne FIG 2A) but over a plateau between the narrow and wide trenches. Thus Kuehne does not teach “forming a opening in said mask layer in said first region and over trenches of said first set of trenches” and “removing a layer of said layer of said fill material exposed in said opening” as Applicants claim 22 requires.

Based on the preceding arguments, Applicants respectfully maintain that Kuehne does not anticipate claim 22, and that claim 22 is in condition for allowance. Since claims 19-21, 23, 24 and 27-30 depend from claim 22, Applicants contend that claims 19-21, 23, 24 and 27-30 are likewise in condition for allowance.

Second 35 U.S.C. §102 Rejection

The Examiner rejected claims 11, 13, 14 and 17-24 under 35 U.S.C. §102(e) as allegedly being anticipated by Jang et al. (US Pat. 6,869,858, hereinafter Jang).

The Examiner rejected claims 11, 13, 14 and 17-24 under 35 U.S.C. §102(e) as allegedly being anticipated by Jang et al. (US Pat. 6,372,605, hereinafter Jang) stating: “Jang in figs. 6, 8 and 10 disclose a method of fabricating a filled trench structure, comprising: forming a planarization stop layer 28 on a top surface of a substrate 10; forming a first set of trenches in a first region W2 of planarization stop layer and substrate and forming a second set of trenches in a second region W3 of planarization stop layer and substrate, trenches in first set of trenches having a higher aspect ratio than trenches in second region (fig. 6 and col. 10, line 62 through col. 11, line 7); depositing a fill material 22 in first and second set of trenches and on a top surface of planarization stop layer 28, fill material completely filling trenches (col. 11, lines 8-28); removing an upper portion of fill material 22 by an etched back process (dry/wet etching) (fig. 8 and col. 12, lines 4-17); and (e) removing, using a planarization process, all fill material from top surface of planarization stop layer, a top surface of fill material in first and second sets of trenches co-planer with top surface of planarization stop layer (fig. 10 and col. 12, lines 4-56).”

As to claim 11, Applicants respectfully contend that Jang does not anticipate claim 11, as amended, because Jang does not teach each and every feature of claim 11. In a first example, Jang does not teach “a first thickness of said layer of said fill material directly over each trench of said first set of trenches greater than a second thickness of said layer of said fill material directly over each trench of said second set of trenches, said first and second thicknesses

measured perpendicularly from a plane coplanar with said top surface of said planarization stop layer to a top surface of said layer of said fill material.”

Applicants respectfully point out, that in the process illustrated Jang FIG. 6, (and FIG. 8) clearly shows the thickness of layer 12 to be the same over trenches 23a and 23b on the left side of FIG. 6 (narrow trenches) and over trench 23c on the right side of the FIG. 6 (wide trench). FIG. 6 further indicates that the height of fill material in trenches 23a, 23b and 23c is the same, namely “H”.

In a second example, Jang does not teach “non-selectively removing, using a non-planarization process, an entire uppermost layer of said fill material from over said first and second regions and said top surface of said planarization stop layer to form a thinned layer of said fill material.”

Applicants point out that in Jang FIG. 8, fill material is selectively (not non-selectively) removed in opening 22d and that the entire fill material is removed not “thinned” as Applicants claim 11 requires. The only other removal step in FIG. 6, 8 and 10 is a planarization process.

Support for the limitation “a first thickness of said layer of said fill material directly over each trench of said first set of trenches greater than a second thickness of said layer of said fill material directly over each trench of said second set of trenches, said first and second thicknesses measured perpendicularly from a plane coplanar with said top surface of said planarization stop layer to a top surface of said layer of said fill material” is found in Applicants FIG. 3 and paragraphs 0019 and 0020 discussion of heights H2 and H3.

Support for the negative limitation “non-selectively removing” in amended claim 11 is found in paragraph 0034 of Applicants specification which states in part “The major difference

between the first and second embodiments of the present invention is that no masking step is performed in the second embodiment of the present invention.”

Based on the preceding arguments, Applicants respectfully maintain that Jang does not anticipate claim 11, and that claim 11 is in condition for allowance. Since claims 13, 15-18, 25 and 26 depend from claim 11, Applicants contend that claims 13, 15-18, 25 and 26 are likewise in condition for allowance.

As to claim 17, Jang does not teach and the Examiner did not assert that Jang teaches “wherein said first region is a memory cell array region and said second region is a support circuit region of an integrated circuit” as Applicants claim 17 requires. Applicants cannot find this limitation in Jang and respectfully request the Examiner point out where this limitation is found in Jang.

Based on the preceding arguments, Applicants respectfully maintain that Jang does not anticipate claim 17, and that claim 17 is in condition for allowance.

As to claim 19, Applicants respectfully contend that Jang does not anticipate claim 19, as amended, because Jang does not teach each and every feature of claim 19. For example, Jang does not teach “a first volume of fill material in said first region not completely contained in said trenches of said first set of trenches is about equal to a second volume of fill material in said second region not completely contained in said trenches of said second set of trenches.”

Applicants cannot find any teaching of *relative* volumes of the two regions in Jang. There is no such teaching in the text of the specification and such a teaching can not be determined from the two-dimensional drawings of Jang FIGs. 2A through 2E.

Based on the preceding arguments, Applicants respectfully maintain that Jang does not anticipate claim 19, and that claim 19 is in condition for allowance.

As to claim 21, Applicants respectfully contend that Jang does not anticipate claim 21, as amended, because Jang does not teach each and every feature of claim 21. For example, Jang does not teach “wherein (d) reduces the difference between a volume of said fill material over first region and a volume of said fill material over said second region.”

Applicants cannot find any teaching of a reduction in the *difference* in volume between two regions in Jang. There is no such teaching in the text of the specification and such a teaching cannot be determined from the two-dimensional drawings of Jang FIGs. 6, 8 and 10.

Based on the preceding arguments, Applicants respectfully maintain that Jang does not anticipate claim 21, and that claim 21 is in condition for allowance.

As to claim 22, Applicants respectfully contend that Jang does not anticipate claim 22, as amended, because Jang does not teach each and every feature of claim 22. For example, Jang does not teach “(d), after (c): (i) forming a mask layer on said layer of fill material; (ii) forming a opening in said mask layer in said first region and over trenches of said first set of trenches; (iii) removing a layer of said layer of said fill material exposed in said opening, said fill material still completely filling each trench of said first set of trenches; and (iv) removing said masking layer.”

Applicants point out that In FIG. 8 of Jang that opening 22d in photoresist layer 29a/b/c is not over any narrow trenches 23a or 23 b (see Jang FIG 6) but over a plateau in the region containing wide trenches. Thus Jang does not teach “forming a opening in said mask layer in

said first region and over trenches of said first set of trenches” and “removing a layer of said layer of said fill material exposed in said opening” as Applicants claim 22 requires.

Based on the preceding arguments, Applicants respectfully maintain that Jang does not anticipate claim 22, and that claim 22 is in condition for allowance. Since claims 19-21, 23, 24 and 27-30 depend from claim 22, Applicants contend that claims 19-21, 23, 24 and 27-30 are likewise in condition for allowance.

35 U.S.C. § 103(a)

The Examiner rejected claims 15, 16 and 20 under 35 U.S.C. 103(a) as allegedly being unpatentable over Jang et al. (US Pat. 6,869,858).

First, Applicants have argued *supra* in response to the Examiners § 102(b) rejections of claims 11 and 22 that claims 11 and 12 are allowable, since claims 15 and 16 depend from claim 11 and claim 20 depends from claim 22, Applicants respectfully maintain that claims 15, 16 and 20 are not unpatentable over Jang and are in condition for allowance.

Second, the Examiner stated: "Jang fails to disclose the fill material is removed about 5 to 20% of the as deposited thickness (claims 15&20); and the aspect ratio of the first/second trenches (claim 16). It would have been obvious to one with ordinary skill in the art at the time of the invention to perform an etched back process step as taught by Jang. The amount of the fill material being etched and the aspect ratio of the first/second trenches does not define patentable over Jang since it is well known processing variable and the discovery of the optimum or workable range involves only routine skill in the art. The specific amount of the semiconductor being etched does not provide any critical or unexpected results to the method of manufacturing a semiconductor device. Rather, it is merely an obvious selection of the etching amount based on desired functional characteristics determinable by routine experimentation. In *Aller*, the court stated, "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." *In re Aller*, 220 F.2d 454, 456 105 USPQ 233,235 (CCPA 1995)."

(1) Applicants note that the rejection of claims 15, 16 and 20 in the present office action is identical to the rejection Applicants appealed in the Appeal Brief filed on June 1, 2007 and which Applicants were advised by the Examiner were persuasive. The Examiner stated,

“Applicant’s arguments, see Brief of Appellant, filed 06/01/07, with respect to the rejection of claims 11 and 13-20 have been fully considered and are persuasive. Sine the Examiner has not presented any new grounds for rejecting claims 15, 16 and 20, Applicants believe the present rejection of claims 15, 16 and 20 is improper and claims 15, 16 and 20 are allowable over Jang.

(2) Applicants contend that the Examiner has offered no evidence that “the amount of fill material being etched” or the “aspect ratio” are processing variable effective to solve the problems described by Applicants in the simultaneous fabrication of different aspect ratio trenches known in the art. To the contrary, Applicants assert in paragraph [0025] to have discovered (i) the aspect ratio is not the primary cause of the problem and (ii) it is the volume of fill material that is the problem. Applicants state in paragraph [0025] that “the difference in removal rates of fill layer 150 is not a function of the values H1, H2, H3, and H4 as illustrated in FIG. 3, but of the relative volume of fill layer 150 in first and second regions 130 and 140.” It is this discovery that forms the foundation for “removing about 5 to 20% of the as deposited thickness” that Applicants claim.

Based on the preceding arguments, Applicants respectfully maintain that claims 15, 16, and 20 are not unpatentable over Jang et al. and are in condition for allowance.

CONCLUSION

Based on the preceding arguments, Applicants respectfully believe that all pending claims and the entire application meet the acceptance criteria for allowance and therefore request favorable action. If Examiner believes that anything further would be helpful to place the application in better condition for allowance, Applicants invite the Examiner to contact the Applicants' representative at the telephone number listed below. The Director is hereby authorized to charge and/or credit Deposit Account 09-0458 (IBM).

Respectfully submitted,
FOR: Economikos et al.

Dated: 11/7/07

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